

CLAIMS

1. We claim a fuel cell consisting of positive and negative electrodes, electrical current extractor lines, electrode catalyst, ion exchange membrane, fuel and oxidizer channels, integral channeled top plate feeding fuel and oxidizer manifold supply chambers with said structures all disposed on one side of a single (monolithic) substrate and all said structures fabricated sequentially on the said single side of a monolithic substrate.
2. The fuel cell of claim 1 wherein the ion exchange process takes place predominantly in a direction parallel to the surface of a single monolithic substrate.
3. The fuel cell of claim 1 wherein the dimensions of the ion exchange membrane orthogonal to the plane of the substrate and perpendicular to ion flow may be much larger than the dimensions in the plane of the substrate in order to facilitate a larger surface area for ion exchange and to yield higher output power density per unit area of substrate.
4. The fuel cell of claim 1 wherein such cell consists of a single fuel cell or a multiplicity of single fuel cells disposed over a single monolithic substrate.
5. The fuel cell of claim 1 wherein all components described are disposed on one side of a monolithic substrate.
6. The fuel cell of claim 1 wherein the substrate is comprised of insulating, semi-insulating, semiconducting, or conductive material.
7. The fuel cell of claim 1 wherein singulated fuel cell elements or arrays of unsingulated fuel cell elements are stacked and interconnected to form a higher output power module than would be available from a single fuel cell element or an array of fuel cell elements on a single substrate.

8. The fuel cell of claim 1 wherein individual fuel cells within a single substrate are electrically interconnected to yield a cell array connected variously in series or parallel to provide a variable voltage or current range.
9. The fuel cell of claim 1 wherein manifold supply chambers provide for stacking of individual fuel cells or arrays of fuel cells whereby such manifold chambers are in registration thus allowing the passage of fuel and oxidizer through multiply stacked fuel cells or arrays of fuel cells.
10. The fuel cell of claim 1 wherein a multiplicity of fuel cells fabricated on a single substrate can be singulated then stacked by hermetically bonding one to another.
11. The fuel cell of claim 1 wherein a multiplicity of single fuel cells on a single substrate are interconnected such that electrical current extractor lines are routed to the edge of a single substrate to provide connection to external devices or electrical loads.
12. The fuel cell of claim 1 wherein a monolithic semiconductor substrate contains pre-existing active semiconductor circuits for the purpose of controlling operation of the fuel cell.
13. The fuel cell of claim 1 wherein the monolithic substrate contains active MEMS type devices for controlling mechanical functions of the fuel cell.
14. The fuel cell of claim 1 wherein all the functional elemental parts of said fuel cell or cells are fabricated by sequential processing on one side of a single monolithic substrate.
15. The fuel cell of claim 1 wherein the fuel cell structure may be a Proton Exchange Membrane (PEMFC) type or a Solid Oxide Type (SOFC) or Solid Polymer Type (SPFC), depending on the selection of fabrication materials.

16. The fuel cell of claim 1 wherein the fuel source is comprised of alcohols, hydrogen gas, or other fuels containing redox pairs.
17. The fuel cell of claim 1 wherein the oxidizer source is air or oxygen.
18. The fuel cell of claim 1 wherein the operating temperature range may be from 80°C to 800°C depending on the type of said cell and the material system used.
19. The fuel cell of claim 1 wherein the anode and cathode electrodes are alternated in a single plane on a monolithic single substrate.
20. The fuel cell of claim 1 wherein the fuel and oxidizer channels and electrical conductors are configured in a comb pattern.
21. The fuel cell of claim 1 wherein the lateral dimensions of the electrical conductors, the membrane material, the electrodes and the fuel and oxidizer channel separators are within the range of from 5 μm to 1 mm. for the purpose of using standard semiconductor and microfabrication manufacturing techniques.
22. The fuel cell of claim 1 wherein the electrical current extractor lines and the substrate are of high thermal conductivity for the purpose of removing heat from the active region of the fuel cell.
23. The fuel cell of claim 1 wherein structure buildup is accomplished by methods common in the semiconductor and MEMS fabrication industry including but not limited to physical vapor deposition, chemical vapor deposition, plating, spin coating, dipping, spraying and cladding.
24. The fuel cell of claim 1 whereby structure patterning is accomplished by standard semiconductor or MEMS photomasking technique followed by etch removal or additive deposition techniques.

25. The fuel cell of claim 1 wherein masking is accomplished using standard photoresist and lithography printing techniques common in the semiconductor and MEMS fabrication industry.

26. The fuel cell of claim 1 wherein subtractive removal is accomplished using either laser ablation, stamping, ultrasonic grinding, lapping or polishing, machining, or wet or dry etching.

27. The fuel cell of claim 1 wherein subtractive feature formation is accomplished by vacuum etching processes such as sputter etching, reactive ion etching, reactive ion beam etching, deep reactive ion etching.

28. The fuel cell of claim 1 wherein anode and cathode electrical conductor lines are comprised of plated copper, gold, nickel or palladium or a combination of those.

29. The fuel cell of claim 1 wherein an inert corrosion barrier is comprised of a patterned refractory conductor such as tantalum nitride, titanium-tungsten nitride, or rhodium.

30. The fuel cell of claim 1 wherein a membrane material is deposited by spin coating, dipping, or chemical vapor deposition.

31. The fuel cell of claim 1 wherein the electrode material is applied to anisotropically etched holes in a membrane by spin coating, dipping or doctor blading, followed by heat curing.

32. The fuel cell of claim 1 wherein an insulating barrier layer is applied to the surface of conductive elements by vacuum deposition, chemical vapor deposition or other conventional means for the purpose of electrically insulating one element from another or eliminating corrosion between dissimilar materials.

33. The fuel cell of claim 1 wherein metallic layers are built by plating copper, nickel, gold, or a combination thereof, for example.